260237

FLOOD INSURANCE STUDY

NEWARK PUBLIC LIBRARY

DEC 19 1980

U. S. GOVT. PUBS.
DEPOSITORY 375

TOWNSHIP OF PLYMOUTH, MICHIGAN

WAYNE COUNTY

SEPTEMBER 2, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 260237

FEMA 209

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Purpose of Study	1
1.2	Authority and Acknowledgements	1
1.3	Coordination	1
2.0	AREA STUDIED	2
2.1	Scope of Study	2
2.2	Community Description	4
2.3	Principal Flood Problems	5
2.4	Flood Protection Measures	5
3.0	ENGINEERING METHODS	9
3.1	Hydrologic Analyses	9
3.2	Hydraulic Analyses	10
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	12
4.1	Flood Boundaries	12
4.2	Floodways	13
5.0	INSURANCE APPLICATION	16
5.1	Reach Determinations	16
5.2	Flood Hazard Factors	17
5.3	Flood Insurance Zones	17
5.4	Flood Insurance Rate Map Description	18

best copy available

TABLE OF CONTENTS (Continued)

		Page
6.0	OTHER STUDIES	18
7.0	LOCATION OF DATA	18
8.0	REFERENCES AND BIBLIOGRAPHY	20

FIGURES

Figure	1	-	Vicinity Map	3
Figure	2	-	Looking South at intersection of Plymouth Road and Edward Hines Road	6
Figure	3	-	Flood hazard from Tonquish Creek at Joy Road	6
Figure	4	-	Flood hazard from Tonquish Creek at Sheldon Road	7
Figure	5	-	Flood hazards from Tonquish Creek on Beacon Hill Drive	7
Figure	6	-	Damage in the Township of Plymouth by flood of April 1979	8
Figure	7	-	Floodway Schematic	16

TABLES

Table	1	-	Summary of Discharges	11
Table	2	-	Floodway Data	14
Table	3	-	Flood Insurance Zone Data	19

TABLE OF CONTENTS (Continued)

EXHIBITS

Exhibit 1 - Flood Profiles

Tonquish Creek	Panels	01P - 02P
South Branch Tonquish Creek	Panel	04P - 05P
Johnson Drain	Panel	06P

Exhibit 2 - Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

TOWNSHIP OF PLYMOUTH,
WAYNE COUNTY, MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Plymouth, Wayne County, Michigan, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Township of Plymouth to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Wade, Trim & Associates, Inc. for the Federal Insurance Administration, under Contract No. H-4542. This study was completed in August 1979.

1.3 Coordination

During the course of study by Wade, Trim & Associates, Inc., flood elevations, flood boundaries, and floodway delineations were reviewed with community officials and with officials of the Michigan Department of Natural Resources (MDNR).

Identification of flooding sources requiring detailed study was done at a meeting attended by personnel and officials of the Township of Plymouth and representatives of Wade, Trim and Associates, Inc. on January 4, 1978. The township was contacted regarding base maps, population data, zoning

and land use information, flood plain ordinances, topographic maps, flood control measures, flood photos, and other pertinent data.

The U.S. Geological Survey (USGS), Water Resources Division was contacted regarding the availability of USGS publications relevant to southeast Michigan. The Southeast Michigan Council of Governments (SEMCOG) was contacted in reference to flood related publications which are available. The Wayne County Drain Office was contacted regarding available data relative to Wayne County Drains. The MDNR was contacted regarding information relative to flood insurance studies. The U.S. Department of Agriculture, Soil Conservation Service (SCS) provided information on Tonquish Creek.

On March 13, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by personnel and residents of Plymouth Township, the FIA, and personnel of the Study Contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Plymouth. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction through May 1984.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the Township of Plymouth.

The flooding sources studied by detailed methods are listed below:

a. Tonquish Creek from Joy Road to Ann Arbor Road and Sheldon Road to just upstream of North Territorial Road;

b. South Branch Tonquish Creek from Sheldon Road to just upstream of Ann Arbor Trail; and

c. Johnson Drain within the corporate limits.

Flooding of the Middle River Rouge within the township was studied by approximate methods.

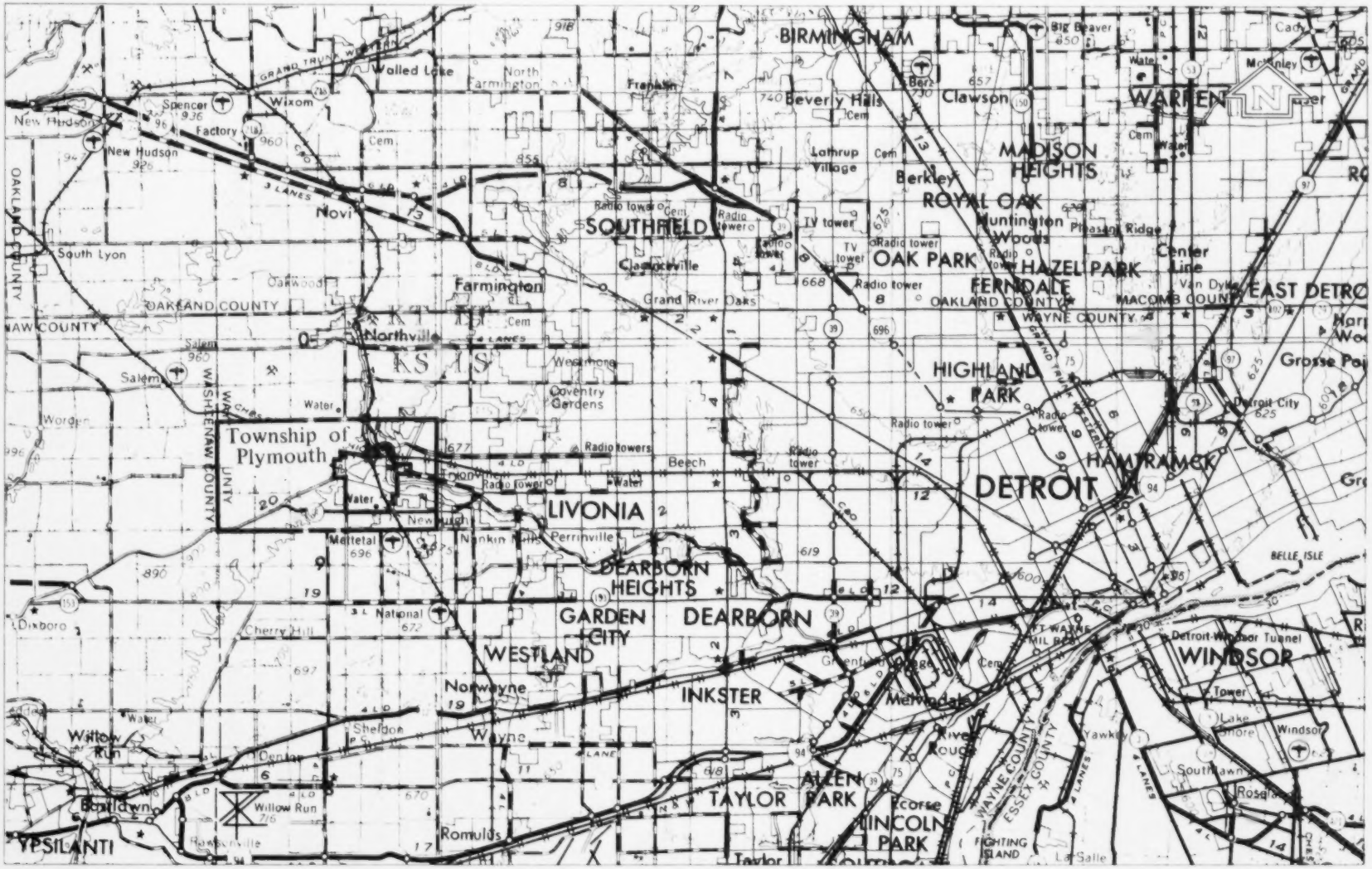


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

2.2 Community Description

The Township of Plymouth is located in the northwest portion of Wayne County in southeast Michigan and is totally within the Rouge River drainage basin. The township is bordered by the Township of Northville to the north, the City of Livonia to the east, the Township of Canton to south, and the Township of Salem in Washtenaw County to the west. The Township of Plymouth entirely surrounds the City of Plymouth. According to U.S. Census Bureau figures, the 1970 population of Plymouth was 17,500 and the 1975 estimate by SEMCOG was 19,500 (References 1, 2, 3, and 4).

While no major climatologic stations are located in the Township of Plymouth, there are several stations which adequately describe the climate of the township (References 5, 6, and 7). The climate of the Township of Plymouth is modified by the Great Lakes, resulting in fewer days having temperatures over 100 degrees Fahrenheit (F.) or below 0 degrees F. The mean annual temperature is 45 degrees F. with an average frost-free season from approximately May 7 to October 10. Precipitation is slightly greater during the summer than during the winter. Generally, the month of greatest precipitation is June, which averages somewhat more than 4 inches, while the month of least precipitation is February with slightly more than 1 inch occurring. The average annual precipitation is approximately 32 inches. Extreme variations in rainfall intensity occur in the area due to the "Heat Island" effects of metropolitan Detroit. Snowfall in the area averages approximately 35 inches annually.

The soils in the area are all of glacially related origin. The upland soils are developed primarily in clay drift or sandy and gravel. The downstream lake bed soils are predominantly clay, silt, or fine sands. Most areas have considerable vegetative cover except those areas undergoing rapid urbanization (Reference 8).

The Johnson Drain, flowing across the northwest corner of the township, has a drainage area of approximately 15 square miles at its downstream terminous with Plymouth. The drainage area decreases to 13.5 square miles at the western limits of the township. The watershed land area is rural in nature consisting of rolling hills and scattered woodlands. South Branch Tonquish Creek has a drainage area of approximately three square miles. It flows in a southeasterly direction into the City of Plymouth where it converges with Tonquish Creek, just north of Ann Arbor Road. Tonquish Creek has a drainage basin of approximately nine square miles. The Middle River Rouge flows in a somewhat southeasterly direction through the township for approximately three miles. Two lakes, Phoenix Lake and Newburgh Lake, extend into the township from the neighboring communities of Northville and Livonia. A third lake, Wilcox Lake, lies along the northeast boundary, between the township and the City of Plymouth.

Most development within the township has been residential with the exception of a few scattered commercial facilities. There has been industrial development along Plymouth Road in the township. The major commercial growth in the area has occurred within the City of Plymouth. The Detroit House of Correction for Men is located in the northwest corner of the township. The township contains approximately 16 square miles and has maintained its rural/residential suburban nature over the years. However, the surrounding township has received much new growth in recent years. The western third of the township remains rural in nature. Development pressures are being felt as subdivision activity moves westward from the City of Plymouth. A major highway, State Highway 14, is proposed to traverse the northern portion of the township, intersecting Interstate Highway 275 which presently runs through the eastern edge of the community. There is a parkway along the Middle Branch River Rouge. The river flows south from Northville, to the northern edge of the City of Plymouth and eastward into the City of Livonia.

The land along the upper reaches of South Branch Tonquish Creek is currently feeling development pressures while the lower reaches run through areas recently developed as single-family subdivisions. The land along the upper reaches of Tonquish Creek is currently feeling development pressures while the lower reaches run through areas developed as single-family residential subdivisions. Much of the land along the Middle River Rouge within the township has been retained as recreational public land. The Johnson Drain flood plain is generally undeveloped.

2.3 Principal Flood Problems

The history of flooding within the Township of Plymouth indicates that the main flooding season is during the winter and spring. Floods due to sudden intense local thunderstorms have also been recorded and may occur at anytime during the summer.

Combinations of weather and other natural occurances have created flooding problems within the community. The most recent flood, caused by a severe, high intensity rainstorm occurred in June 1968. Other floods have occurred in May 1948, April 1950, and March 1954. The June 1968 flood was estimated to be between a 10-and 25-year event (Reference 8). Figures 2 through 6 show views of past and projected flood hazards in the Township of Plymouth.

2.4 Flood Protection Measures

In the community, some development has occurred within the flood plain area, but through local planning, development within the flood plain has been restricted. Along both Tonquish Creek and South Branch Tonquish

FIGURE 2 - Looking south at intersection of Plymouth Road and Edward Hines Drive during flood of June 1978.

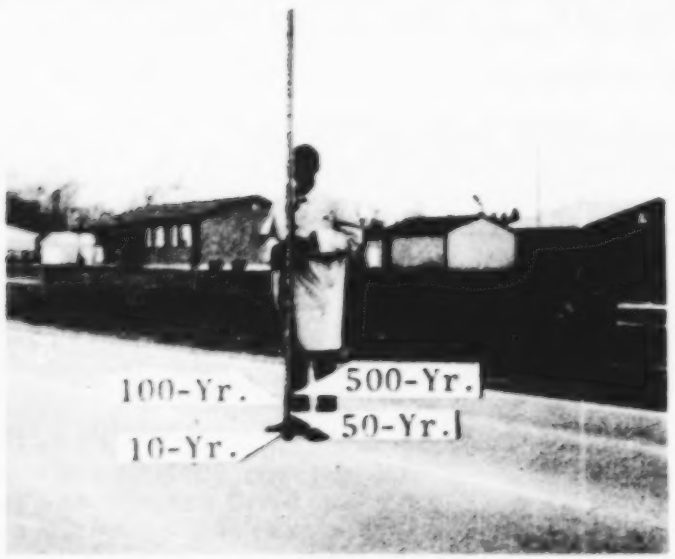


FIGURE 3 - Flood hazard from Tonquish Creek at Joy Road.

FIGURE 4 - Flood hazard from Tonquish Creek at Sheldon Road.

FIGURE 5 - Flood hazard from Tonquish Creek on Beacon Hill Drive.

FIGURE 6 - Flood damage in the Township of Plymouth caused by flood of April 1979.

Creek, land within the flood plain has been set aside for use as park or open space. Dams constructed along the course of the Middle River Rouge create small lakes to function as holding ponds during times of excessive runoff. The levees along Johnson Drain will not contain the 100-year flood.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

In the detailed study of the Johnson Drain, four studies were used in determining runoff relationships. These included a detailed hydrologic analysis of the entire Johnson Drain as part of a Flood Insurance Study currently being conducted for the City of Northville (Reference 9), the Flood Hydrograph Method based upon a study of drainage basins in southeast Michigan (Reference 10), the SCS Technique HUD-21, utilizing data from four sources (References 11, 12, 13, and 14), and hydrologic data from File No. 2791-3 of the MDNR. Of these four types of analyses, the SCS technique appeared to be most representative of this drainage basin as it incorporates the size, shape, soils, and particularly the land use in the basin. The results of this method are indicated in Table 1.

Hydrologic data for the detailed study of Tonquish Creek and South Branch Tonquish Creek were taken from two reports, one prepared by the SCS, and a hydrologic analysis by the Study Contractor for the Wayne County Drain Commissioner (References 15 and 16).

Both analyses considered current watershed land use to determine floodflow frequency data and also utilized the SCS-TR 20 flood routing computer model (Reference 17). After discussion with the MDNR, it was decided that the discharges calculated by the SCS were more applicable to the combined basin. Discharges for both Tonquish Creek and the South Branch Tonquish Creek at selected points are also indicated in Table 1.

Approximate floodflow data for the Middle River Rouge was obtained from detailed Flood Insurance Studies for the Cities of Novi and Northville and the Township of Northville (References 18, 9, and 19).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analysis of the Tonquish Creek from Joy Road to Ann Arbor Road and from Sheldon Road to North Territorial Road were obtained from the SCS as part of the Tonquish Creek analysis (Reference 8). The South Branch Tonquish Creek backwater analyses, from Sheldon Road to Ann Arbor Trail, were also obtained from the same SCS report. Cross sections for the Johnson Drain were obtained from field survey data conducted in January 1978. Field survey data is supplemented by USGS Quadrangle Maps of the study area (Reference 20).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") for hydraulic computations, used by the SCS for Tonquish Creek and South Branch Tonquish Creek, varied from 0.04 to 0.06 and roughness values for the overbanks varied between 0.05 to 0.125. Roughness values for the Johnson Drain were estimated by field inspection at each cross section. The typical roughness value used for the main channel was 0.035 and overbank areas varied between 0.06 and 0.10 for all floods. Contraction and expansion coefficients were selected as 0.3 and 0.5 at bridge sections and 0.1 and 0.3 for gradual channel transitions. These values are indicative of summer month conditions and are consistent with roughness values recommended and used in engineering practice.

Starting water-surface elevations for Tonquish Creek and South Branch Tonquish Creek were obtained from the SCS Flood Hazard Analyses (Reference 8). Starting water-surface elvations for Johnson Drain were

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
JOHNSON DRAIN					
Upstream of Five Mile Road	15	400	700	850	1,300
TONQUISH CREEK					
Upstream of North Territorial Road	2.1	250	380	450	610
Upstream of Dunn Court	2.5	330	465	545	720
Upstream of Sheldon Road	2.9	330	465	545	720
Upstream of Joy Road	7.1	800	1,135	1,320	1,770
SOUTH BRANCH TONQUISH CREEK					
Upstream of Canton Center Road	2.0	100	155	185	250
From downstream of Canton Center Road	2.0	250	370	440	590
Upstream of Sheldon Road	2.5	250	370	440	590

obtained from backwater calculations of the railroad bridge located 70 feet downstream of the downstream corporate limits. Normal depth analysis of Johnson Drain in the vicinity of the railroad bridge indicated that this bridge acts as a control structure; therefore, the headwater elevations obtained from analysis of this structure were used for the starting water-surface elevations. The SCS WSP-2 backwater program was used in calculating water-surface profiles for Tonquish Creek and South Branch Tonquish Creek (Reference 21). The HEC-2 backwater program was used in developing water-surface profiles for the Johnson Drain (Reference 21). For the Middle River Rouge, the approximate boundaries were determined using normal depth calculations. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps photoenlarged to a scale of 1:12000, with a contour interval of 10 feet (Reference 20).

For the Middle River Rouge, the boundary of 100-year flood was delineated on topographic maps referenced above. The approximate zone delineations, other than those for Middle River Rouge, were taken from the FIA, Flood Hazard Boundary Map for the Township of Plymouth (Reference 23).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Michigan though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (Reference 23), encroachment in the flood plain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Bureau of Water Management, a floodway having no more than a 0.1-foot surcharge has been delineated for this study. The floodway for Johnson Drain is contained within the levees on both banks.

The floodway presented in this study for Johnson Drain was determined on the basis of equal conveyance reduction from each side of the flood plain. The floodways for Tonquish Creek and South Branch Tonquish Creek were set to coincide with the 100-year flood plain, excluding areas of noneffective flow. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 7.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
TONQUISH CREEK								
A	33,999	500	1208	1.8	693.2	693.2	693.2	0.0
B	34,040	500	1208	1.8	693.2	693.2	693.2	0.0
C	34,880	225	729	3.5	694.4	694.4	694.4	0.0
D	35,980	110	321	5.6	696.6	696.6	696.6	0.0
E	36,769	55	474	4.0	697.8	697.8	697.8	0.0
F	45,463	190	141	5.3	737.2	737.2	737.2	0.0
G	46,060	140	296	2.2	738.3	738.3	738.3	0.0
H	47,210	240	206	3.5	747.6	747.6	747.6	0.0
I	48,480	390	332	2.7	755.5	755.5	755.5	0.0
J	49,320	60	118	5.6	761.6	761.6	761.6	0.0
K	49,430	80	167	4.3	762.3	762.3	762.3	0.0
L	49,511	170	537	1.3	765.9	765.9	765.9	0.0
M	50,200	130	476	1.2	766.5	766.5	766.5	0.0
N	51,020	220	188	2.8	770.8	770.8	770.8	0.0
O	51,030	220	210	2.7	770.9	770.9	770.9	0.0
P	51,119	220	912	0.5	774.9	774.9	774.9	0.0
SOUTH BRANCH TONQUISH CREEK								
A	4196	60	78	5.7	716.6	716.6	716.6	0.0
B	4235	70	96	4.9	717.4	717.4	717.4	0.0
C	4650	80	105	4.4	719.1	719.1	719.1	0.0
D	5037	55	140	3.6	720.5	720.5	720.5	0.0
E	5115	55	518	1.2	722.5	722.5	722.5	0.0
F	6050	90	131	3.4	726.0	726.0	726.0	0.0
G	7703	45	106	4.2	736.6	736.6	736.6	0.0
H	7807	45	251	1.9	739.4	739.4	739.4	0.0

[1] FEET ABOVE MOUTH

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOODWAY DATA

TONQUISH CREEK - SOUTH BRANCH TONQUISH CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
SOUTH BRANCH TONQUISH CREEK								
I	9580	320	353	3.1	746.5	746.5	746.5	0.0
J	11,092	190	231	2.7	755.4	755.4	755.4	0.0
K	11,110	190	1325	0.4	758.0	758.0	758.0	0.0
L	11,354	240	268	2.2	758.9	758.9	758.9	0.0
M	11,406	350	725	0.7	760.9	760.9	760.9	0.0
JOHNSON DRAIN								
A	23[2]	52	262	3.2	834.8	834.8	834.8	0.0
B	73[2]	86	352	4.6	834.8	834.8	834.8	0.0
C	1223[2]	56	206	8.4	836.4	836.4	836.4	0.0
D	2223[2]	65	304	5.9	838.8	838.8	838.8	0.0
E	3223[2]	66	307	5.4	840.0	840.0	840.0	0.0
F	4473[2]	69	383	4.2	841.0	841.0	841.0	0.0
G	5723[2]	40	220	5.6	841.7	841.7	841.7	0.0
H	6323[2]	50	208	7.6	842.4	842.4	842.4	0.0
I	6823[2]	50	208	7.6	843.6	843.6	843.6	0.0

[1]FEET ABOVE MOUTH
[2]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOODWAY DATA

SOUTH BRANCH TONQUISH CREEK - JOHNSON DRAIN

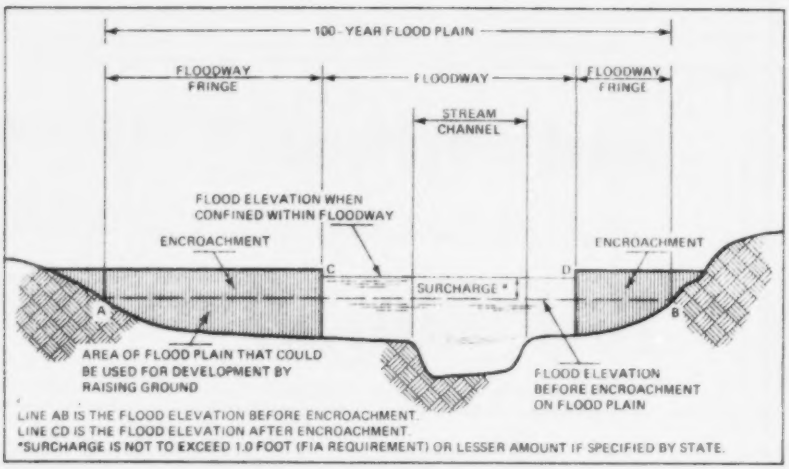

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 7 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the Township of Plymouth.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the Township of Plymouth are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Plymouth was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A1, A2, A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for Township of Plymouth flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Plymouth is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Flood Insurance Studies are currently being conducted for the City of Plymouth (Reference 25), which is encircled by the Township of Plymouth; the Township of Northville (Reference 19), which is adjacent to the community on the north; the Charter Township of Canton (Reference 26), which is to the south; and the City of Livonia (Reference 27), which is to the east. The results of this study will match the other noted studies.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 23). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
TONQUISH CREEK							
REACH 1	0005	−0.8	−0.3	0.4	010	A2	VARIES–SEE MAP
REACH 2	0005	−0.5	−0.3	0.4	005	A1	VARIES–SEE MAP
SOUTH BRANCH TONQUISH CREEK							
REACH 1	0005	−1.2	−0.4	0.5	010	A2	VARIES–SEE MAP
JOHNSON DRAIN							
REACH 1	0005	−2.4	−0.7	1.7	025	A5	VARIES–SEE MAP

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOOD INSURANCE ZONE DATA

TONQUISH CREEK - SOUTH BRANCH TONQUISH CREEK - JOHNSON DRAIN

8.0 REFERENCES AND BIBLIOGRAPHY

1. Southeast Michigan Council of Governments, Population and Occupied Dwelling Units in Southeast Michigan 1975, June 1975.

2. ----------, Population and Occupied Dwelling Units in Southeast Michigan 1975, April 1976.

3. ----------, Population and Occupied Dwelling Units in Southeast Michigan 1976, April 1977.

4. ----------, Population and Occupied Dwelling Units in Southeast Michigan, First 6 months of 1977, October 1977.

5. Michigan Department of Agriculture, Climate of Michigan by Stations, State of Michigan, 1971.

6. U.S. Department of Commerce, U.S. National Weather Service and National Oceanographic and Atmospheric Administration, 5 to 60 Minute Precipitation Frequency for East-Central United States, 1977.

7. Southeast Michigan Council of Governments, Precipitation in Southeast Michigan, March 1976.

8. U.S. Department of Agriculture, Soil Conservation Service, Tonquish Creek Flood Hazard Analyses, June 1968.

9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Northville, Wayne County, Michigan, (in progress).

10. Brater, E.F., Rainfall-Runoff Relations on Urban and Rural Areas, University of Michigan for the Michigan State Highway Department, 1975.

11. Michigan Department of Natural Resources, Bureau of Land and Water Management, Hydrologic Engineering Section, SCS Methodology, Richard C. Sorrell, May 1977.

12. U.S. Department of Agriculture, Soil Conservation Sevice, Soil Survey of Wayne County Area, Michigan, Novembr 1977.

13. ----------, Soil Survey of Washtenaw County Area, Michigan, April 1974.

14. ----------, National Engineering Handbook, Section 4, Hydrology, 1972.

15. Flood Hazard Analyses, Tonquish Creek, Wayne County, Michigan, December 1977.

16. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, A Computer Program for Project Formulation, Hydrology, May 1965.

17. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Novi, Wayne County, Michigan, April 1978.

18. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Northville, Wayne County, Michigan, (in progress).

19. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: Wayne Quadrangle, Wayne County, (photorevised) 1973.

20. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 61, WSP-2 Computer Program, Washington, D.C., May 1976.

21. U.S. Army Corps of Engineers, HEC-2 Water-Surface Profile, Users Manual, 1976.

22. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Plymouth, Michigan, October 1975.

23. State of Michigan, Flood Plain Control Act of 1968. Act 245, P.A. 1928 as amended by Act 167, P.A. 1868, Michigan Water Resources Commission, Lansing, Michigan, 1968.

24. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Plymouth, Michigan, (in progress).

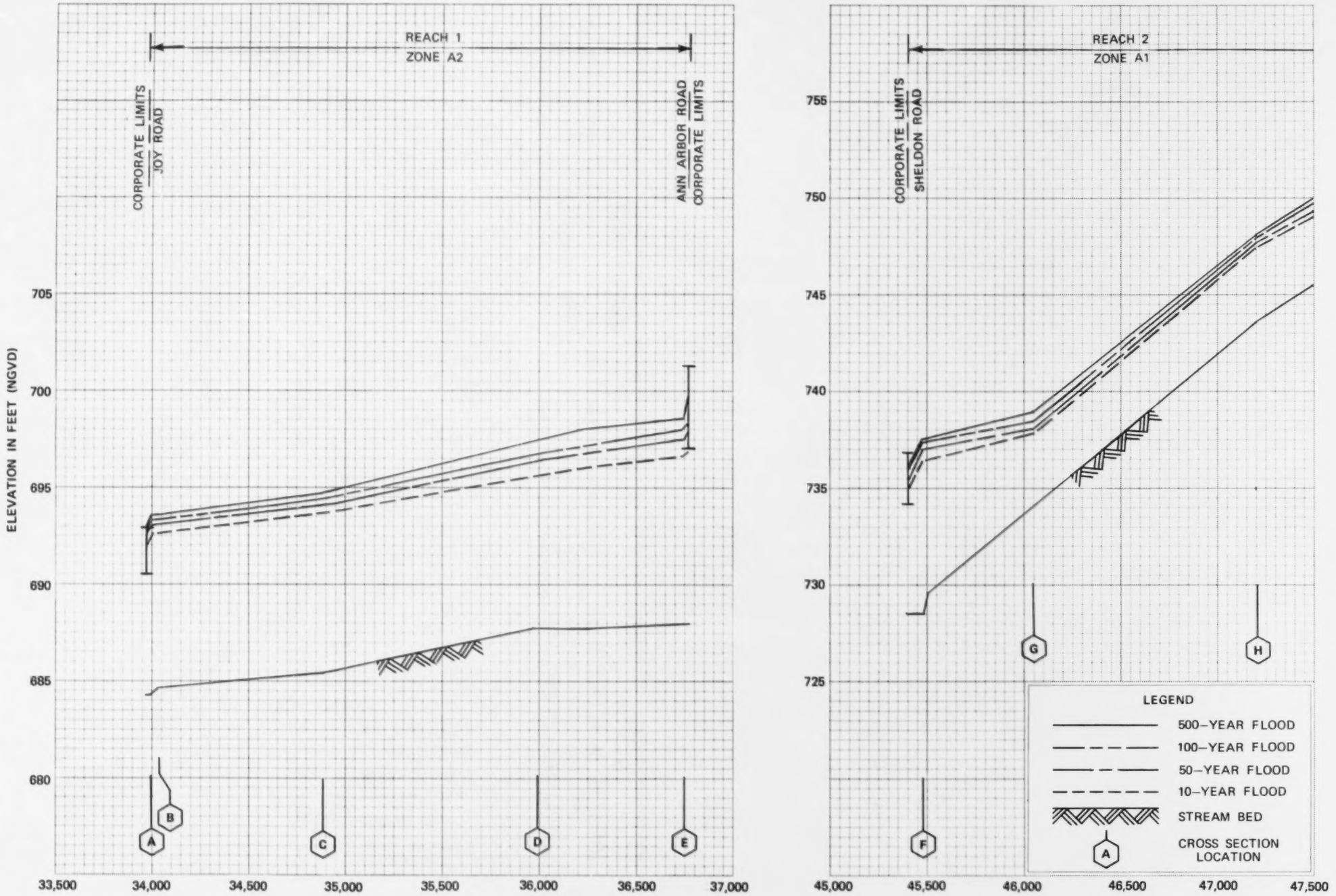
25. ————, Charter Township of Canton, Michigan, (in progress).

26. ————, City of Livonia, Michigan, (in progress).

U.S. Army Corps of Engineers, Detroit District, Flood Plain Information, Middle Rouge River, Township of Northville , Michigan, 1971.

U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, 1972.

U.S. Department of Housing and Urban Development, Final Hydrology Report, Tonquish Creek for the City of Plymouth, Township of Plymouth, and Township of Canton, April 1979.



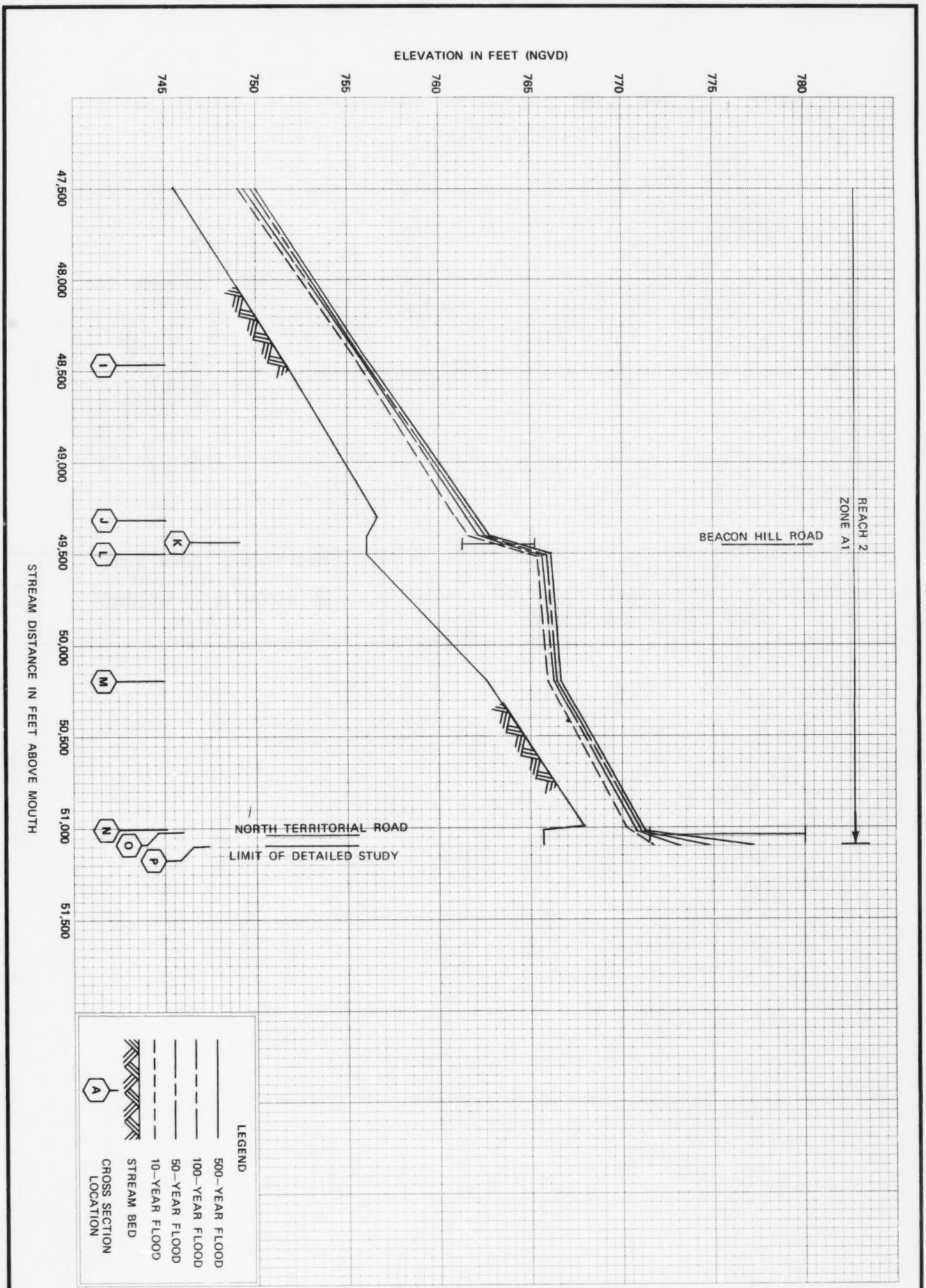
FLOOD PROFILES

TONQUISH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

01P



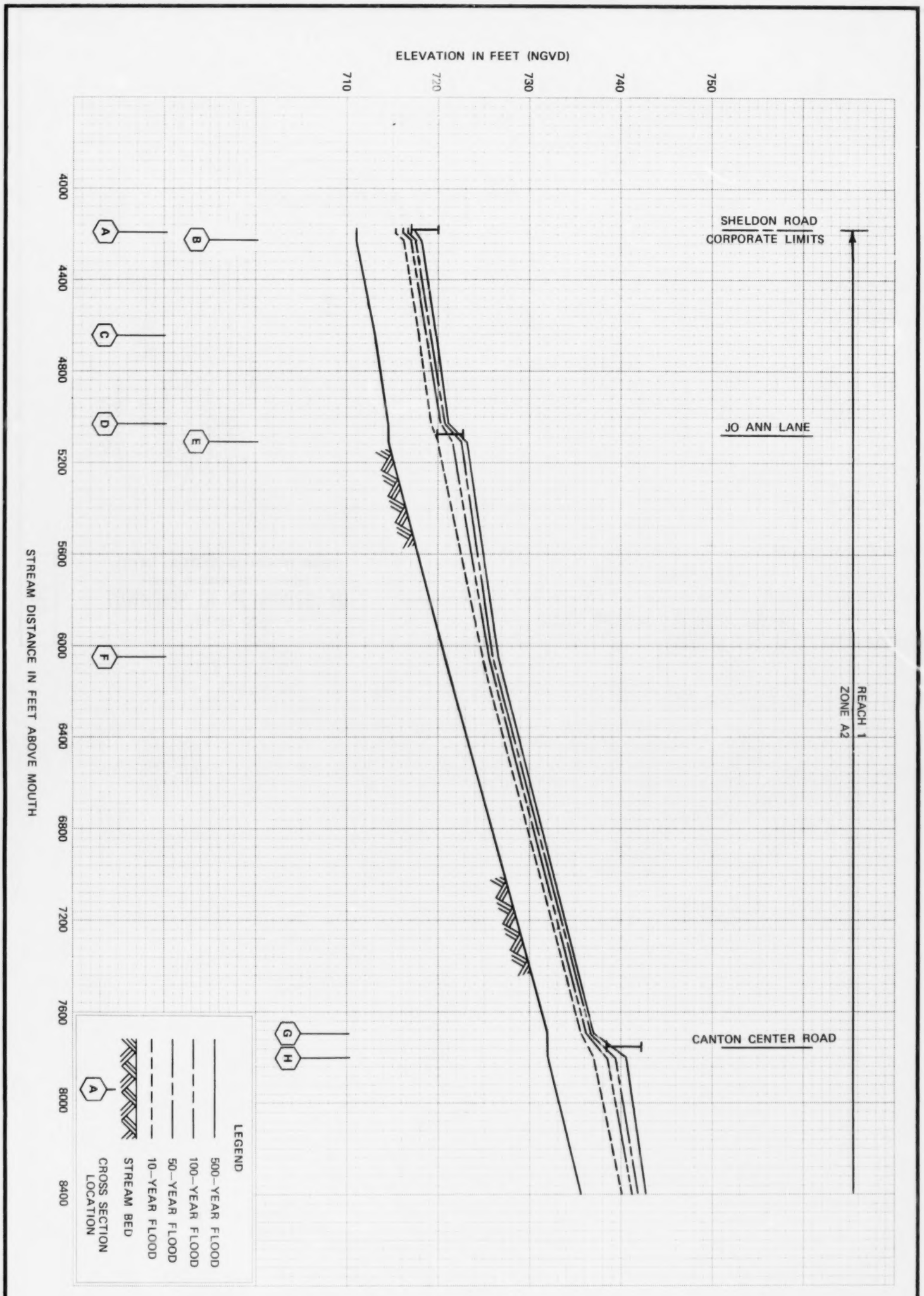
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOOD PROFILES

TONQUISH CREEK

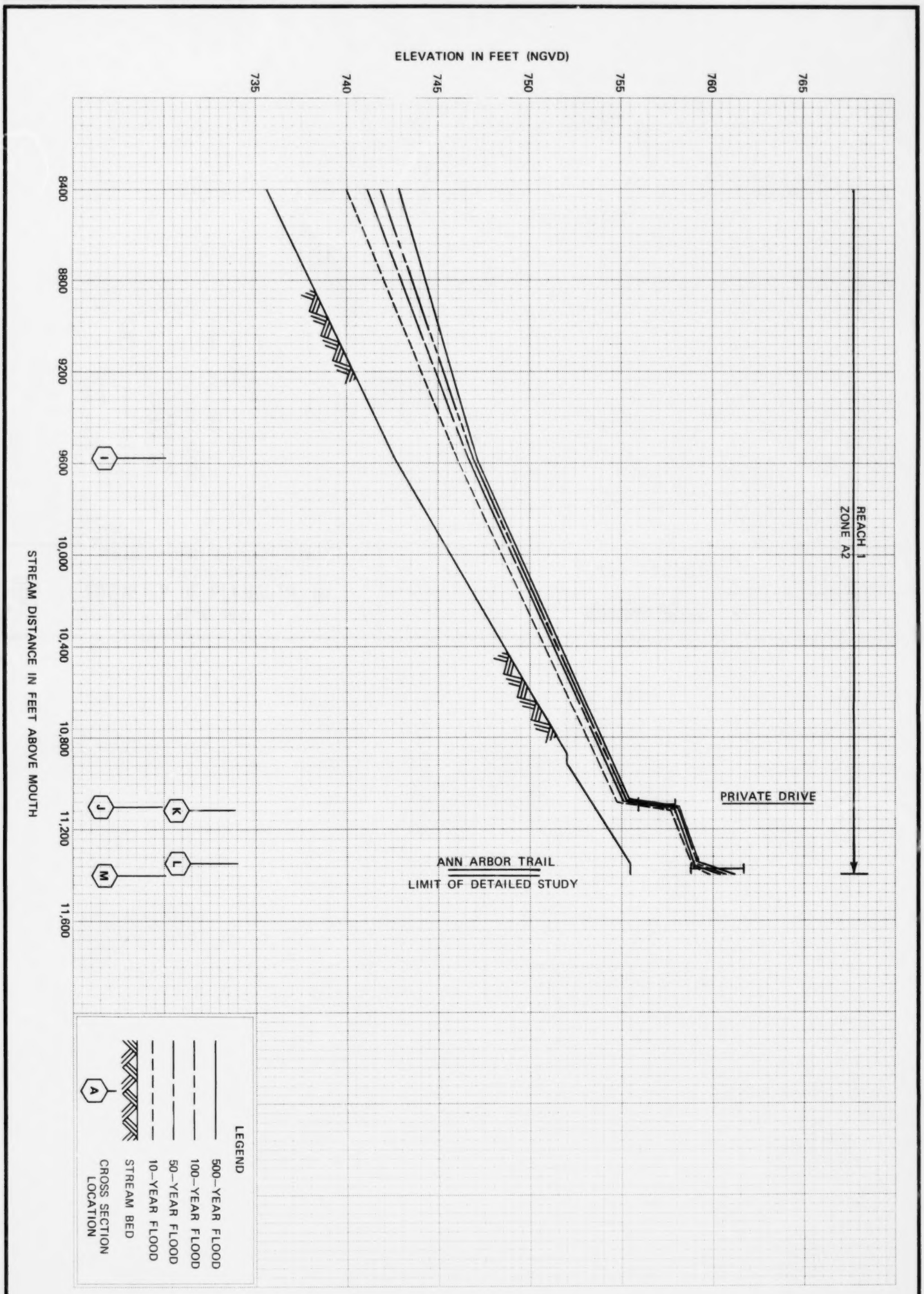


03P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOOD PROFILES

SOUTH BRANCH TONQUISH CREEK



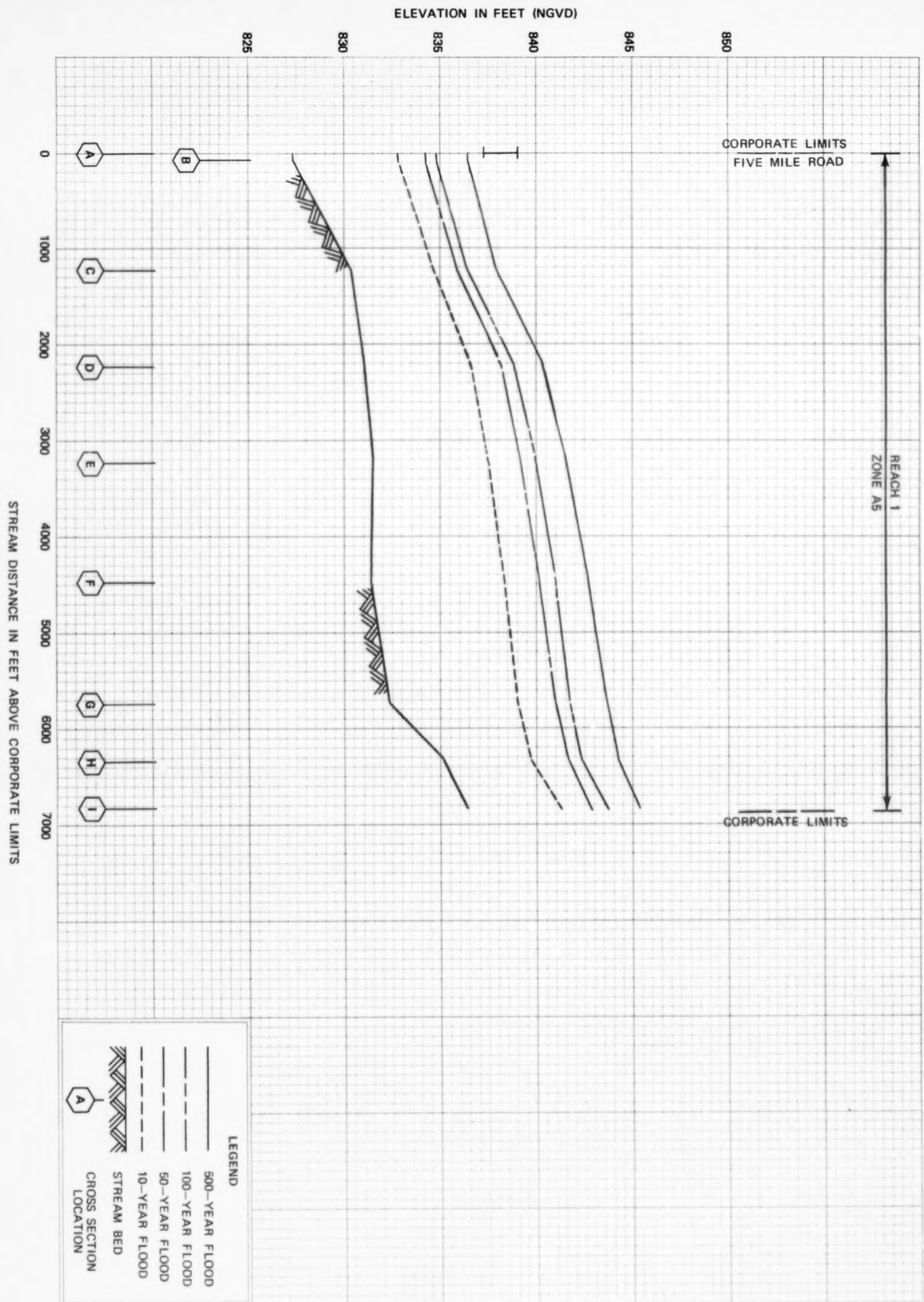
04P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOOD PROFILES

SOUTH BRANCH TONQUISH CREEK



05P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF PLYMOUTH, MI
(WAYNE CO.)

FLOOD PROFILES

JOHNSON DRAIN